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VOLUNTARY AMENDMENT

(AMENDMENT UNDER PROVISIONS OF LAW, ARTICLE 11)

To: Japan Patent Office Examiner: Yoichi Sato

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1 INDICATION OF INTERNATIONAL APPLICATION
PCT/JP2005/003805

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4. SCOPE OF AMENDMENT

20 (1) Description
(2) Claims

5. CONTENT OF AMENDMENT

1) In the Description, page 3, line 23 to line 24,
we amend "Al: 0.01 to 1.8%" to "Al: 0.25 to 1.8%".
25 2) In the Description, page 4, line 4 to line 5,
we delete "further contains Al, by mass%, of 0.25 to 1.8%
in range and in that".
3) In the Description, page 4, line 18 to line 19,
we amend "Al: 0.01 to 1.8%" to "Al: 0.25 to 1.8%".
30 4) In the Description, page 5, line 23 to line 25,
we delete "further contains Al, by mass%, of 0.25 to 1.8%
in range and in that"
5) In the Description, page 7, line 16 to line 18,
we amend "from the viewpoint of improving the ductility,
35 Al has to be included in an amount of 0.01% or more" to
"from the viewpoint of improving the ductility, Al has to
be included in an amount of 0.25% or more".

6) In the Description, page 7, line 22 to line 24, we delete "From the viewpoint of securing the steel sheet strength, addition of 0.25% to 1.8% is preferable".

7) In the Description, page 16, Table 1/Ingredients, we delete Steel types A, B and amend the table as in the attachment.

8) In the Description, page 17, Table 1 (continued), we delete Steel types A, B and amend the table as in the attachment.

9) In the Description, page 18, Table 2/Method of Production (1), we delete Experiment numbers 1, 2 and amend the table as in the attachment.

10) In the Description, page 19, Table 2 (continued), we delete Experiment numbers 1, 2 and amend the table as in the attachment.

11) In the Description, page 20, Table 3/Method of Production (2), we delete Experiment numbers 1, 2 and amend the table as in the attachment.

12) In the Description, page 21, Table 3 (continued), we delete Experiment numbers 1, 2 and amend the table as in the attachment.

13) In the Claims, page 24, claim 3, line 24 to line 25, we delete "further contains Al, by mass%, of 0.25 to 1.8% in range and in that".

14) In the Claims, page 25, claim 4, line 1 to line 2, we amend "Al: 0.01 to 1.8%" to "Al: 0.25 to 1.8%".

15) In the Claims, page 26, claim 8, line 7, we delete "further contains Al, by mass%, of 0.25 to 1.8% in range and in that".

6. LIST OF ATTACHED DOCUMENTS

- (1) New page for Description, page 3, one copy
- (2) New page for Description, page 4, one copy
- (3) New page for Description, page 5, one copy
- (4) New page for Description, page 7, one copy
- (5) New page for Description, page 16, one copy
- (6) New page for Description, page 17, one copy
- (7) New page for Description, page 18, one copy

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- (8) New page for Description, page 19, one copy
- (9) New page for Description, page 20, one copy
- (10) New page for Description, page 21, one copy
- (11) New page for Claims, page 24, one copy
- (12) New page for Claims, page 25, one copy
- (13) New page for Claims, page 26, one copy

elongation, and that by applying the necessary heat treatment after the hot dip galvanization step, a material stable in hole enlargement ability and embrittlement can be obtained. The inventors discovered that in steel sheet designed based on this technical idea, by making low yield stress DP steel a metal structure mainly comprised of ferrite in accordance with the conventional residual austenite steel and tempered martensite with an area rate of 5% to 60%, it is possible to secure an elongation greater than before and obtain a DP structure excellent in hole enlargement ability and optimal for hot dip galvanization.

Further, in the present invention, to prevent delayed fracture and secondary embrittlement or other problems from occurring, the unavoidably included 5% or less residual austenite may be allowed. The present invention is based on the above technical idea and has as its gist the following:

(1) A hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability characterized by containing, by mass%, C: 0.01 to 0.3%, Si: 0.005 to 0.6%, Mn: 0.1 to 3.3%, P: 0.001 to 0.06%, S: 0.001 to 0.01%, Al: 0.25 to 1.8%, and N: 0.0005 to 0.01% and having a balance of Fe and unavoidable impurities, wherein the metal structure is comprised of ferrite and, by area ratio, 5% to 60% of tempered martensite.

(2) A hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in (1), characterized in that said hot dip galvanized composite high strength steel sheet further contains, by mass%, one or more of Mo: 0.05 to 0.5%, V: 0.01 to 0.1%, Ti: 0.01 to 0.2%, Nb: 0.005 to 0.05%, Cu: 1.0% or less, Ni: 1.0% or less, Cr: 1.0% or less, Ca: 0.0003 to 0.005%, REM: 0.0003 to 0.005%, and B: 0.0003 to 0.002%.

(3) A hot dip galvanized composite high strength

steel sheet excellent in shapeability and hole enlargement ability as set forth in (1) or (2), characterized in that said hot dip galvanized composite high strength steel sheet the mass% of Si and Al and the target tensile strength (TS) satisfy the following equation 1:

$$(0.0012 \times [\text{TS target value}] - 0.29 - [\text{Si}]) / 1.45 < \text{Al} < 1.5 - 3 \times [\text{Si}] \dots \text{equation 1}$$

[TS target value]: Design value of tensile strength of steel sheet (MPa), [Si]: Si mass%, Al: Al mass%

(4) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability characterized by hot rolling, then cold rolling a slab containing, by mass%, C: 0.01 to 0.3%, Si: 0.005 to 0.6%, Mn: 0.1 to 3.3%, P: 0.001 to 0.06%, S: 0.001 to 0.01%, Al: 0.25 to 1.8%, and N: 0.0005 to 0.01% and having a balance of Fe and unavoidable impurities, heating the sheet in a hot dip galvanization heating step to A_{c1} to $A_{c3} + 100^\circ\text{C}$ in temperature, holding it there for 30 seconds to 30 minutes, then cooling it by a 1°C/s or higher cooling rate to 450 to 600°C in temperature, then hot dip galvanizing it at that temperature, then cooling it by a 1°C/s or higher cooling rate to the martensite transformation point or less in temperature, then holding it at 200°C to 500°C in temperature for 1 second to 5 minutes, then cooling it by a 5°C/s or higher cooling rate to 100°C or less so as to obtain a metal structure comprised of ferrite and of tempered martensite of an area rate of 5% to 60%.

(5) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in (4), characterized by performing alloying after said hot

dip galvanization.

(6) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in (4) or (5), characterized by said further treating a galvanized layer or galvannealed layer by one or more of a chromate treatment, inorganic coating film treatment, chemical conversion, or resin coating film treatment.

(7) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in any one of (4) to (6), characterized in that said hot dip galvanized composite high strength steel sheet further contains, by mass%, one or more of Mo: 0.05 to 0.5%, V: 0.01 to 0.1%, Ti: 0.01 to 0.2%, Nb: 0.005 to 0.05%, Cu: 1.0% or less, Ni: 1.0% or less, Cr: 1.0% or less, Ca: 0.0003 to 0.005%, REM: 0.0003 to 0.005%, and B: 0.0003 to 0.002%.

(8) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in any one of (4) to (7), characterized in that said hot dip galvanized composite high strength steel sheet the mass% of Si and Al and a target tensile strength (TS) satisfy the following equation 1:

$$(0.0012 \times [\text{TS target value}] - 0.29 - [\text{Si}]) / 1.45 < \text{Al} < 1.5 - 3 \times [\text{Si}] \dots \text{equation 1}$$

[TS target value]: Design value of tensile strength of steel sheet (MPa), [Si]: Si mass%, Al: Al mass%

(9) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in any one of (4) to (8), characterized by, from said cold rolling to the hot dip galvanization heating step, preplating one or more of Ni, Fe, Co, Sn, and Cu to 0.01

sheet, but if the amount of addition is large, it segregates at the grain boundary, so degrades the local ductility and simultaneously degrades the weldability, so the upper limit value of P was made 0.06%. On the other
5 hand, the lower limit of P was made 0.001% to avoid an increase in cost of refining.

Further, S is an element forming MnS and thereby degrading the local ductility and the weldability. It is an element preferably not present in the steel, so the
10 upper limit value was made 0.01%. The lower limit was made 0.001% to avoid an increase in cost of refining.

Al is an element required for promoting the formation of ferrite and is effective in improving the ductility. Even if a large amount is added, it does
15 not inhibit the hot dip galvanizability. Further, it acts as a deoxidizing element. Therefore, from the viewpoint of improving the ductility, Al has to be included in an amount of 0.25% or more, but even if Al is excessively added, its effect becomes saturated and conversely the
20 steel becomes embrittled. Simultaneously, the hot dip galvanization ability is reduced. Therefore, the upper limit was made 1.8%.

N is an unavoidably included element, but when included in a large amount, not only is the aging effect
25 deteriorated, but also the amount of deposition of AlN becomes greater and the effect of addition of Al is reduced, so 0.01% or less is preferably contained. Further, unnecessarily reducing the N increases the cost in the steel making process, so normally the amount of N
30 is controlled to 0.0005% or more.

In the present invention, when further higher strength is required, to improve the plating adhesion, if adding a large amount of Al instead of Si, in particular
35 when $0.25\% \leq \text{Al} \leq 1.8\%$, by making the balance of Al and Si with TS the following equation 1 in range, sufficient

TS≥980 MPa... 40% or more considered passing

Table 1/Ingredients

Steel type	TS target	C	Si	Mn	P	S	N	Al	Mo	V
C	480	0.018	0.176	1.31	0.032	0.005	0.0070	0.810		
D	500	0.018	0.112	2.35	0.043	0.006	0.0100	0.990		
E	540	0.027	0.074	2.87	0.016	0.003	0.0050	0.430		
F	550	0.030	0.177	1.11	0.016	0.009	0.0050	0.950		
G	560	0.032	0.186	2.78	0.029	0.006	0.0030	0.930		
H	570	0.044	0.100	2.34	0.039	0.002	0.0080	0.300		
I	580	0.058	0.171	2.06	0.056	0.007	0.0030	0.970		
J	580	0.058	0.160	0.17	0.033	0.002	0.0080	0.900	0.180	
K	590	0.071	0.196	1.42	0.037	0.003	0.0050	0.550		
L	640	0.082	0.089	1.15	0.016	0.004	0.0050	1.140		
M	680	0.082	0.081	2.93	0.040	0.001	0.0030	1.050		
N	700	0.093	0.055	1.84	0.007	0.006	0.0070	0.500		
O	760	0.100	0.013	0.70	0.002	0.080	0.0040	0.810		
P	780	0.110	0.122	2.64	0.057	0.009	0.0020	0.730		
Q	800	0.120	0.084	0.17	0.010	0.010	0.0040	0.870		
R	840	0.120	0.148	0.19	0.016	0.008	0.0060	1.000		
S	900	0.134	0.047	0.19	0.042	0.010	0.0070	1.110		
T	920	0.140	0.042	1.71	0.021	0.006	0.0050	0.780		
U	950	0.144	0.076	0.89	0.033	0.011	0.0060	0.580	0.190	
V	950	0.142	0.116	0.27	0.046	0.007	0.0060	0.850	0.250	
W	980	0.147	0.122	0.92	0.035	0.009	0.0070	0.680	0.270	
X	980	0.150	0.107	1.76	0.059	0.006	0.0090	0.880		
Y	1280	0.210	0.153	1.20	0.025	0.005	0.0020	0.780		
Z	1320	0.235	0.176	2.73	0.051	0.008	0.0040	0.850		
AA	950	0.122	0.275	0.27	0.046	0.007	0.0060	0.650		
AB	1180	0.152	0.118	1.95	0.055	0.008	0.0090	0.720	0.280	
AC	1180	0.150	0.107	2.99	0.059	0.006	0.0090	0.880		
AD	1200	0.210	0.299	1.20	0.025	0.005	0.0020	0.600		0.050
AE	1350	0.250	0.233	1.36	0.039	0.009	0.0080	0.750	0.270	
AF	1480	0.289	0.186	2.06	0.052	0.004	0.0080	0.910		
AG	780	0.095	0.247	2.09	0.008	0.007	0.0029	0.892		
AH	780	0.101	0.226	2.68	0.006	0.008	0.0080	1.712		
AI	1130	0.261	0.276	0.43	0.043	0.009	0.0090	0.815		0.050
AJ	1470	0.300	0.289	0.47	0.038	0.005	0.0005	1.391		
AK	1570	0.295	0.395	0.52	0.040	0.004	0.0032	0.212	0.150	
AL	1570	0.298	0.526	0.88	0.049	0.006	0.0069	0.106		
AM	310	0.009	0.202	0.43	0.007	0.010	0.0063	1.778		
AN	1570	0.320	0.113	2.92	0.003	0.006	0.0007	0.462		
AO	980	0.166	0.607	2.64	0.056	0.009	0.0049	0.422		0.050
AP	880	0.113	0.083	0.09	0.049	0.001	0.0006	0.527		
AQ	1180	0.164	0.285	3.44	0.020	0.004	0.0041	1.247	0.072	
AR	780	0.125	0.267	2.06	0.070	0.003	0.0009	0.337		
AS	540	0.058	0.131	2.50	0.002	0.020	0.0059	0.377		
AT	540	0.026	0.145	0.15	0.011	0.010	0.0200	0.273		
AU	720	0.099	0.188	0.45	0.046	0.002	0.0030	0.009		
AV	880	0.130	0.186	2.39	0.051	0.006	0.0030	2.010		

Table 1 (continued)

[illegible]

Table 2/Method of Production (1)

Exper. no.	Steel type	TS (MPa)	EL (%)	TSxEL	(A) equation				(A) equation judgment
					TS target value (MPa)	(A) equation left side	Al	(A) equation right side	
3	C	476	37.9	18040	480	0.076	0.810	0.972	Good
4	D	508	36.9	18745	500	0.137	0.990	1.164	Good
5	E	551	33.0	18183	540	0.196	0.430	1.278	Good
6	F	549	33.1	18172	550	0.133	0.950	0.969	Good
7	G	568	32.5	18460	560	0.135	0.930	0.942	Good
8	H	582	31.9	18566	570	0.203	0.300	1.200	Good
9	I	591	30.9	18262	580	0.162	0.970	0.987	Good
10	J	584	31.2	18221	580	0.170	0.900	1.020	Good
11	K	605	29.9	18090	590	0.153	0.550	0.912	Good
12	L	632	30.1	19023	640	0.268	1.140	1.233	Good
13	M	688	28.7	19746	680	0.307	1.050	1.257	Good
14	N	695	27.2	18904	700	0.341	0.500	1.335	Good
15	O	743	24.8	18426	760	0.420	0.810	1.461	Good
16	P	812	23.2	18838	780	0.361	0.730	1.134	Good
17	Q	825	22.8	18810	800	0.404	0.870	1.248	Good
18	R	852	21.5	18318	840	0.393	1.000	1.056	Good
19	S	905	20.1	18191	900	0.512	1.110	1.359	Good
20	T	899	20.5	18430	920	0.532	0.780	1.374	Good
21	U	952	19.0	18088	950	0.534	0.580	1.272	Good
22	V	934	19.5	18213	950	0.506	0.850	1.152	Good
23	W	987	19.1	18852	980	0.527	0.680	1.134	Good
24	X	1024	18.2	18637	980	0.537	0.880	1.179	Good
25	Y	1320	14.9	19668	1280	0.754	0.780	1.041	Good
26	Z	1400	13.5	18900	1320	0.771	0.850	0.972	Good
27	AA	965	19.9	19204	950	0.397	0.650	0.675	Good
28	AB	1206	15.2	18331	1180	0.695	0.720	1.146	Good
29	AC	1230	15.8	19434	1180	0.703	0.880	1.179	Good
30	AD	1220	15.3	18666	1200	0.587	0.600	0.603	Good
31	AE	1364	13.4	18278	1350	0.757	0.750	0.801	Poor
32	AF	1520	12.2	18544	1480	0.897	0.910	0.942	Good
33	AG	795	22.5	17888	780	0.275	0.892	0.759	Poor
34	AH	825	20.9	17243	780	0.290	1.712	0.822	Poor
35	AI	1158	15.1	17486	1130	0.545	0.815	0.672	Poor
36	AJ	1476	12.2	18007	1470	0.817	1.391	0.633	Poor
37	AK	1584	11.4	18058	1570	0.827	0.212	0.315	Poor
38	AL	1603	11.3	18114	1570	0.737	0.106	-0.078	Poor
39	AM	335	33.2	11122	310	-0.083	1.778	0.894	Poor
40	AN	1623	7.8	12659	1570	1.021	0.462	1.161	Poor
41	AO	985	17.5	17238	980	0.192	0.422	-0.321	Poor
42	AP	885	18.5	16373	880	0.471	0.527	1.251	Good
43	AQ	1235	10.2	12597	1180	0.580	1.247	0.645	Poor
44	AR	795	20.1	15980	780	0.261	0.337	0.699	Good
45	AS	587	26.5	15556	540	0.157	0.377	1.107	Good
46	AT	557	31.2	17378	540	0.147	0.273	1.065	Good
47	AU	750	22.2	16650	720	0.266	0.009	0.936	Poor
48	AV	899	18.6	16721	880	0.400	2.010	0.942	Poor

Table 2 (continued)

Experiment no.	Tempered martensite area (%)	Hole enlargement rate (%)	Plating adhesion	Plating appearance	Class
3	<5%	73	Good	Very good	Comp. ex.
4	<5%	70	Very good	Very good	Comp. ex.
5	<5%	66	Very good	Very good	Comp. ex.
6	<5%	65	Good	Very good	Comp. ex.
7	<5%	63	Good	Very good	Comp. ex.
8	<5%	61	Very good	Very good	Comp. ex.
9	<5%	60	Good	Good	Comp. ex.
10	<5%	62	Good	Good	Comp. ex.
11	<5%	58	Good	Very good	Comp. ex.
12	<5%	60	Very good	Very good	Comp. ex.
13	<5%	58	Very good	Very good	Comp. ex.
14	<5%	56	Very good	Very good	Comp. ex.
15	<5%	55	Very good	Very good	Comp. ex.
16	<5%	54	Good	Very good	Comp. ex.
17	<5%	53	Very good	Very good	Comp. ex.
18	<5%	51	Good	Very good	Comp. ex.
19	<5%	50	Very good	Very good	Comp. ex.
20	<5%	49	Very good	Very good	Comp. ex.
21	<5%	44	Good	Very good	Comp. ex.
22	<5%	47	Good	Very good	Comp. ex.
23	<5%	46	Good	Very good	Comp. ex.
24	<5%	45	Good	Very good	Comp. ex.
25	<5%	38	Good	Good	Comp. ex.
26	<5%	37	Good	Good	Comp. ex.
27	<5%	48	Good	Good	Comp. ex.
28	<5%	39	Good	Good	Comp. ex.
29	<5%	41	Very good	Very good	Comp. ex.
30	<5%	40	Good	Good	Comp. ex.
31	<5%	37	Good	Good	Comp. ex.
32	<5%	35	Good	Good	Comp. ex.
33	<5%	54	Good	Good	Comp. ex.
34	<5%	52	Good	Good	Comp. ex.
35	<5%	41	Good	Good	Comp. ex.
36	<5%	35	Good	Good	Comp. ex.
37	<5%	34	Good	Good	Comp. ex.
38	<5%	33	Good	Good	Comp. ex.
39	<5%	64	Good	Good	Comp. ex.
40	<5%	27	Good	Very good	Comp. ex.
41	<5%	47	Fair	Fair	Comp. ex.
42	<5%	45	Very good	Very good	Comp. ex.
43	<5%	30	Fair	Fair	Comp. ex.
44	<5%	50	Good	Good	Comp. ex.
45	<5%	56	Good	Very good	Comp. ex.
46	<5%	60	Good	Very good	Comp. ex.
47	<5%	50	Good	Good	Comp. ex.
48	<5%	49	Poor	Poor	Comp. ex.

Table 3/Method of Production (2)

Exper. no.	Steel type	TS (MPa)	EL (%)	TSxEL	(A) equation				(A) equation judgment
					TS target value (*) (MPa)	(A) equation left side	Al	(A) equation right side	
3	C	443	42.4	18791	440	0.043	0.810	0.972	Good
4	D	467	40.2	18798	460	0.103	0.990	1.164	Good
5	E	501	36.3	18201	500	0.163	0.430	1.278	Good
6	F	511	37.1	18928	510	0.100	0.950	0.969	Good
7	G	523	35.4	18512	520	0.102	0.930	0.942	Good
8	H	530	35.1	18584	530	0.170	0.300	1.200	Good
9	I	550	34.6	19022	540	0.129	0.970	0.987	Good
10	J	537	34.0	18272	530	0.128	0.900	1.020	Good
11	K	551	32.9	18108	550	0.120	0.550	0.912	Good
12	L	594	33.7	20028	590	0.227	1.140	1.233	Good
13	M	633	31.3	19801	630	0.266	1.050	1.257	Good
14	N	653	29.9	19547	650	0.300	0.500	1.335	Good
15	O	706	27.8	19606	700	0.370	0.810	1.461	Good
16	P	747	25.3	18891	740	0.328	0.730	1.134	Good
17	Q	767	25.1	19243	760	0.371	0.870	1.248	Good
18	R	809	24.1	19490	800	0.360	1.000	1.056	Good
19	S	860	22.3	19182	860	0.479	1.110	1.359	Good
20	T	863	23.2	19992	860	0.483	0.780	1.374	Good
21	U	895	21.1	18873	890	0.484	0.580	1.272	Good
22	V	897	22.4	20107	890	0.457	0.850	1.152	Good
23	W	928	21.2	19670	920	0.477	0.680	1.134	Good
24	X	922	20.2	18618	920	0.488	0.880	1.179	Good
25	Y	1228	16.8	20669	1220	0.704	0.780	1.041	Good
26	Z	1274	15.5	19779	1260	0.721	0.850	0.972	Good
27	AA	907	22.1	20037	890	0.347	0.650	0.675	Good
28	AB	1134	16.9	19127	1120	0.646	0.720	1.146	Good
29	AC	1132	17.9	20204	1120	0.653	0.880	1.179	Good
30	AD	1147	17.6	20178	1140	0.537	0.600	0.603	Good
31	AE	1296	14.9	19274	1290	0.707	0.750	0.801	Good
32	AF	1429	13.5	19349	1420	0.847	0.910	0.942	Good
33	AG	731	25.4	18596	730	0.234	0.892	0.759	Poor
34	AH	751	24.0	18044	740	0.257	1.712	0.822	Poor
35	AI	1077	17.4	18701	1070	0.495	0.815	0.672	Poor
36	AJ	1402	13.8	19331	1400	0.759	1.391	0.633	Poor
37	AK	1457	12.7	18440	1450	0.728	0.212	0.315	Poor
38	AL	1459	12.5	18297	1450	0.637	0.106	-0.078	Poor
39	AM	312	37.2	11585	300	-0.091	1.778	0.894	Poor
40	AN	1493	8.5	12695	1490	0.955	0.462	1.161	Poor
41	AO	896	19.3	17255	890	0.118	0.422	-0.321	Poor
42	AP	823	20.7	17054	820	0.421	0.527	1.251	Good
43	AQ	1136	11.1	12632	1120	0.530	1.247	0.645	Poor
44	AR	723	22.1	15995	720	0.212	0.337	0.699	Good
45	AS	546	29.7	16203	540	0.157	0.377	1.107	Good
46	AT	512	34.0	17427	510	0.122	0.273	1.065	Good
47	AU	683	24.4	16667	680	0.233	0.009	0.936	Poor
48	AV	809	20.3	16404	800	0.334	2.010	0.942	Poor

*: Corrected TS target value considering tempering

Table 3 (continued)

Experiment no.	Tempered martensite area (%)	Hole enlargement rate (%)	Plating adhesion	Plating appearance	Class
3	6.4	86	Good	Very good	Inv. ex.
4	6.7	82	Very good	Very good	Inv. ex.
5	7.8	77	Very good	Very good	Inv. ex.
6	9.0	76	Good	Very good	Inv. ex.
7	9.7	74	Good	Very good	Inv. ex.
8	11.4	72	Very good	Very good	Inv. ex.
9	14.6	71	Good	Good	Inv. ex.
10	13.5	72	Good	Good	Inv. ex.
11	17.2	68	Good	Very good	Inv. ex.
12	20.3	71	Very good	Very good	Inv. ex.
13	21.1	67	Very good	Very good	Inv. ex.
14	21.5	66	Very good	Very good	Inv. ex.
15	22.3	65	Very good	Very good	Inv. ex.
16	24.6	63	Good	Very good	Inv. ex.
17	21.1	61	Very good	Very good	Inv. ex.
18	21.6	60	Good	Very good	Inv. ex.
19	22.8	59	Very good	Very good	Inv. ex.
20	24.3	58	Very good	Very good	Inv. ex.
21	25.2	52	Good	Very good	Inv. ex.
22	25.0	56	Good	Very good	Inv. ex.
23	26.2	55	Good	Very good	Inv. ex.
24	25.9	54	Good	Very good	Inv. ex.
25	42.7	45	Good	Good	Inv. ex.
26	45.5	45	Good	Good	Inv. ex.
27	22.3	57	Good	Good	Inv. ex.
28	26.9	46	Good	Good	Inv. ex.
29	26.7	49	Very good	Very good	Inv. ex.
30	43.0	47	Good	Good	Inv. ex.
31	47.6	45	Good	Good	Inv. ex.
32	50.4	41	Good	Good	Inv. ex.
33	20.9	64	Good	Good	Inv. ex.
34	22.5	62	Good	Good	Inv. ex.
35	47.6	49	Good	Good	Inv. ex.
36	55.3	42	Good	Good	Inv. ex.
37	58.7	40	Good	Good	Inv. ex.
38	59.5	40	Good	Good	Inv. ex.
39	<5%	75	Good	Good	Comp. ex.
40	65.3	36	Good	Very good	Comp. ex.
41	31.2	57	Fair	Fair	Comp. ex.
42	25.1	54	Very good	Very good	Comp. ex.
43	38.0	37	Fair	Fair	Comp. ex.
44	21.4	59	Good	Good	Comp. ex.
45	12.1	66	Good	Very good	Comp. ex.
46	8.5	71	Good	Very good	Comp. ex.
47	22.2	59	Good	Good	Comp. ex.
48	22.4	57	Poor	Poor	Comp. ex.

As will be understood from Example 1, the invention examples described in Table 3 are increased in amount of tempered martensite over the comparative examples of the same experiment numbers described in Table 2 and therefore are improved in hole enlargement ability. Further, when equation 1 is not satisfied, while the passing condition is satisfied, compared with steel types with the same degree of TS, the elongation is poor and,

CLAIMS

1. A hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability characterized by containing, by
5 mass%, C: 0.01 to 0.3%, Si: 0.005 to 0.6%, Mn: 0.1 to 3.3%, P: 0.001 to 0.06%, S: 0.001 to 0.01%, Al: 0.01 to 1.8%, and N: 0.0005 to 0.01% and having a balance of Fe and unavoidable impurities, wherein the metal structure is comprised of ferrite and, by area ratio, 5% to 60% of
10 tempered martensite.

2. A hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in claim 1, characterized in that said hot dip galvanized composite
15 high strength steel sheet further contains, by mass%, one or more of Mo: 0.05 to 0.5%, V: 0.01 to 0.1%, Ti: 0.01 to 0.2%, Nb: 0.005 to 0.05%, Cu: 1.0% or less, Ni: 1.0% or less, Cr: 1.0% or less, Ca: 0.0003 to 0.005%, REM: 0.0003 to 0.005%, and B: 0.0003 to 0.002%.

20 3. (Amended) A hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in claim 1 or 2, characterized in that said hot dip galvanized composite high strength steel sheet the mass% of Si and Al and the
25 target tensile strength (TS) satisfy the following equation 1:

$$(0.0012 \times [\text{TS target value}] - 0.29 - [\text{Si}]) / 1.45 < \text{Al} < 1.5 - 3 \times [\text{Si}] \dots \text{equation 1}$$

[TS target value]: Design value of tensile
30 strength of steel sheet (MPa), [Si]: Si mass%, Al: Al mass%

4. (Amended) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability
35 characterized by hot rolling, then cold rolling a slab containing, by mass%, C: 0.01 to 0.3%, Si: 0.005 to 0.6%, Mn: 0.1 to

3.3%, P: 0.001 to 0.06%, S: 0.001 to 0.01%, Al: 0.25 to 1.8%, and N: 0.0005 to 0.01% and having a balance of Fe and unavoidable impurities, heating the sheet in a hot dip galvanization heating step to A_{c1} to $A_{c3}+100^{\circ}\text{C}$ in temperature, holding it there for 30 seconds to 30 minutes, then cooling it by a 1°C/s or higher cooling rate to 450 to 600°C in temperature, then hot dip galvanizing it at that temperature, then cooling it by a 1°C/s or higher cooling rate to the martensite transformation point or less in temperature, then holding it at 200°C to 500°C in temperature for 1 second to 5 minutes, then cooling it by a 5°C/s or higher cooling rate to 100°C or less so as to obtain a metal structure comprised of ferrite and of tempered martensite of an area rate of 5% to 60%.

5. A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in claim 4, characterized by performing alloying after said hot dip galvanization.

6. A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in claim 4 or 5, characterized by said further treating a galvanized layer or galvannealed layer by one or more of a chromate treatment, inorganic coating film treatment, chemical conversion, or resin coating film treatment.

7. A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in any one of claims 4 to 6, characterized in that said hot dip galvanized composite high strength steel sheet further contains, by mass%, one or more of Mo: 0.05 to 0.5%, V: 0.01 to 0.1%, Ti: 0.01 to 0.2%, Nb: 0.005 to 0.05%, Cu: 1.0% or less, Ni: 1.0% or less, Cr: 1.0% or less, Ca: 0.0003 to 0.005%, REM: 0.0003 to 0.005%, and B:

0.0003 to 0.002%.

8. (Amended) A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in any one of claims 4 to 7, characterized in that said hot dip galvanized composite high strength steel sheet the mass% of Si and Al and a target tensile strength (TS) satisfy the following equation 1:

$$(0.0012 \times [\text{TS target value}] - 0.29 - [\text{Si}]) / 1.45 < \text{Al} < 1.5 - 3 \times [\text{Si}] \dots \text{equation 1}$$

[TS target value]: Design value of tensile strength of steel sheet (MPa), [Si]: Si mass%, Al: Al mass%

9. A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in any one of claims 4 to 8, characterized by, from said cold rolling to the hot dip galvanization heating step, preplating one or more of Ni, Fe, Co, Sn, and Cu to 0.01 to 2.0 g/m² per surface of the steel sheet.

10. A method of production of a hot dip galvanized composite high strength steel sheet excellent in shapeability and hole enlargement ability as set forth in claim 9, characterized by pickling the steel sheet before said preplating.